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10/760,473	01/21/2004	Tamikazu Kume	001458.00040	9811

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EXAMINER	
AFREMOVA, VERA	

ART UNIT	PAPER NUMBER
1651	

DATE MAILED: 03/31/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)	
	10/760,473	KUME ET AL.	
	Examiner	Art Unit	
	Vera Afremova	1651	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *05 January 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1 and 4* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1 and 4* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☒ Other: translation of the reference by Takeshita et al.

DETAILED ACTION

Claims 1 and 4 as amended (1/05/2006) are pending and under examination.

Claims 2 and 3 were canceled by applicants (1/05/2006).

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1 and 4 as amended remain rejected under 35 U.S.C. 102(b) as being anticipated by Takeshita et al. ("Radiation effect of low energy electron beam on plant growth". Food Irradiation Japan, (2000), Vol. 35, No. 1-2, pages 59-63) in the light of evidence by Parniske et al. ("Plant defense response of host with determinate nodules induced by EPS-defective exoB mutants of Bradyrhizobium japonicum". Molecular Plant-Microbe Interactions, (1994) Vol. 7, No. 5, pages 631-638).

Clams are directed to a method of enhancing take of nitrogen fixing microorganisms on plant roots wherein the method comprises step of exposing plant seeds or plant body to a low energy electron beam (EB) having energy 100-500 kev, step of providing an adequate dose for enhancing take of nitrogen fixing microorganisms on plant roots and step of transplanting the plant seed or plant body into soil. Some claims are further drawn to application of the adequate dose such as between 10 Gy and 100 kGy.

Takeshita et al. teaches plant growth enhancing effects of low energy electron beam. The method comprises identical active steps including step of exposing plant seeds to electron beam

having energy within the claimed ranges 100-500 kev (see English abstract) as required by the claimed method, step of providing dose within the claimed ranges 10 Gy to 100 kGy (see English abstract) as required by the claimed method and step of transplanting the seeds into soil for evaluation of plant grow, for example: see official translation page 2, par. 2, line 3.

The English abstract of the reference by Takeshita et al. clearly discloses that irradiated soybean plant had especially significant promotion of root growth and that low energy EB induced phytoalexin activity in soybean plants (English abstract). Thus, there is a reasonable believe as based on the disclosure on English abstract that the nitrogen fixing microorganisms had formed nodules on roots of irradiated soybean plants, particularly in view that phytoalexin induction or accumulation is a plant first response to microbial infection including take of nitrogen fixing microbes as evidenced by Parniske et al. (abstract).

The reference by Takeshita et al. also teaches that "in addition to the irradiated roots growing larger than the non-irradiated roots, even the amount of leguminous bacteria increased noticeably", for example: see official translation page 3, lines 12-15). Thus, the irradiation of seeds provided for enhanced grow of nitrogen fixing leguminous bacteria and, therefore, for enhancing the take of the nitrogen fixing microorganisms on the plant roots within the meaning of the claims.

Thus, the cited reference by Takeshita et al. anticipates the claimed invention.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1 and 4 as amended remain/are rejected under 35 U.S.C. 103(a) as being unpatentable over Takeshita et al taken with US 5,117,579 (Tellefson) and Parniske et al.

Clams are directed to a method of enhancing take of nitrogen fixing microorganisms on plant roots wherein the method comprises step of exposing plant seeds or plant body to a low energy electron beam (EB) having energy 100-500 kev, step of providing an adequate dose for enhancing take of nitrogen fixing microorganisms on plant roots and step of transplanting the plant seed or plant body into soil. Some claims are further drawn to application of the adequate dose such as between 10 Gy and 100 kGy.

The cited reference by Takeshita et al. is relied upon as explained above and it teaches beneficial effects of low energy electron beam irradiation on growth of plants, on growth of plant roots and on growth of leguminous bacteria that fix nitrogen when in symbiotic association with the plants. The method disclosed in the cited reference by Takeshita et al. encompasses treatment of plant seeds and it was applied in experimental greenhouses and trial fields.

In addition, the cited patent US 5,117,579 demonstrates techniques of irradiating plants and/or plant bodies grown in soil on agricultural fields for the benefits of nitrogen fixation. US 5,117,579 (Tellefson) discloses method for enhancing nitrogen fixation wherein the method comprises exposing plants to low energy electron beam by moving electron emitter over filed of crops planted in earth, thereby improving supply of fixed nitrogen to plants (col. 2, lines 49-60). Although the cited US 5,117,579 is silent about total dose of irradiation, the reference by

Takeshita et al teaches doses and energy level that are suitable for irradiating plant parts as intended for improving plant growth and/or growth of nitrogen fixing bacteria.

The reference by Takeshita et al. also teaches that irradiation of soybean seeds with low energy EB induces phytoalexin activity in soybean plants (English abstract) and, thereby, induces activity of nodule microbes or nitrogen fixing microbes as evidenced by Parniske et al. (abstract) since phytoalexin induction or accumulation is a plant first response to microbial invasion including plant root "take of" nitrogen fixing microbes.

Therefore, it would have been obvious to one having ordinary skill in the art at the time the claimed invention was made to irradiate plants with low energy EB with a reasonable expectation of success in promoting plant grow as related to plant-microbial interaction and nitrogen fixation. Thus, the claimed invention as a whole was clearly *prima facie* obvious, especially in the absence of evidence to the contrary.

The claimed subject matter fails to patentably distinguish over the state art as represented be the cited references. Therefore, the claims are properly rejected under 35 USC § 103.

Response to Arguments

Applicants' amendments and arguments filed 1/05/2006 have been fully considered but they are not all found persuasive.

Claim rejection under 35 U.S.C. 102(b) as being anticipated by US 5,117,579 (Tellefson) has been withdrawn because the cited reference does not explicitly disclose the use of the same ranges of energy and doses as required by the claims as amended.

With regard to the cited reference by Takeshita et al applicants argue that the disclosure is mostly directed to improved root growth and that the cited reference is silent about nodule formation or nitrogen fixing organisms (response page 7). This is not found persuasive because the reference by Takeshita et al. clearly teaches that "in addition to the irradiated roots growing larger than the non-irradiated roots, even the amount of leguminous bacteria increased noticeably", for example: see official translation page 3, lines 12-15. Thus, the irradiation of seeds provided for enhanced grow of nitrogen fixing leguminous bacteria and, therefore, for enhancing "the take of the nitrogen fixing microorganisms on the plant roots" within the meaning of the claims. The method disclosed by Takeshita et al comprises identical active steps of exposing plant seed to the same ranges of energy and doses as required by the claimed method. Upon review of translation it is also found that the cited reference recognizes growth enhancement of nitrogen fixing bacteria.

The teaching by Parniske et al is additional evidence related to increased microbial invasion into the root system of irradiated plants including root invasion by nitrogen fixing microorganisms or including "take of" plant roots by nitrogen fixing microorganisms within the meaning of the claims.

No claims are allowed.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL.** See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Vera Afremova whose telephone number is (571) 272-0914. The examiner can normally be reached from Monday to Friday from 9.30 am to 6.00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Wityshyn can be reached at (571) 272-0926.

The fax phone number for the TC 1600 where this application or proceeding is assigned is (571) 273-8300.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Technology center 1600, telephone number is (571) 272-1600.

Vera Afremova

AU 1651

March 29, 2006

V. Afremova

VERA AFREMOVA

PRIMARY EXAMINER

for 10/760,473

PTO 05-4883

Nuclear Research Institute, Vietnam

RADIATION EFFECT OF LOW-ENERGY ELECTRON BEAM ON PLANT GROWTH

Hidefumi Takeshita et al.

UNITED STATES PATENT AND TRADEMARK OFFICE
WASHINGTON, D.C. JULY 2005
TRANSLATED BY THE MCELROY TRANSLATION COMPANY

RADIATION EFFECT OF LOW-ENERGY ELECTRON BEAM ON PLANT GROWTH

Hidefumi Takeshita et al.

(Received on July 24, 2000)

Abstract

Radiation effect of low energy electron beam(EB) on the growth of maize, barley and soybean was investigated. Seeds of maize, barley and soybean were irradiated in the dose range of 2 to 20 kGy using EB with different energy from 150 to 250keV. Growth promotion was observed for irradiated seeds of maize and soybean at the dose up to 10 kGy. Especially, significant promotion of root growth was observed for irradiated barley and soybean. It was also found for soybean that phytoalexin induction activity was clearly enhanced by low energy EB irradiation.

Preface

Promoting the growth of plants leads to a technology for increasing the production of foodstuffs. Irradiation is being investigated as one method wherein such as effect is expected. This is based on the concept that growth of plants is promoted by the stimulation effect resulting from a low dose of radiation. However, though there are many reports regarding the fact that there is an effect in promoting growth and increasing the rate of germination, many lacked reliability from the standpoint of reproducibility. Conventionally, γ-ray of high transmittance was used for the irradiation, hence damage occurred concurrent with the stimulation effect and was considered to make the effect obscure.

Therefore, we conducted an investigation on irradiation of plant seeds using a low-energy electron beam wherein the radiation depth can be adjusted in order to provide a stimulation effect on the surface of the plant body without loss in the growth function intrinsic to plants.

Testing method

1. Electron accelerator

CB 250/15/180 L (electron energy: 100-250 keV) made by Iwasaki Denki was employed for radiating a low-energy electron beam. Also, as supplementary testing, irradiation employing Nuclear Research Institute · Takasaki Research Laboratory's Number 1 Accelerator (electron energy: 500-2000 keV) was also carried out in combination in order to check the effects of the irradiation depth.

2. Samples

As the irradiated plants, seeds of soybean, barley, and maize were used. Also, in order to observe the effects of radiation on one side and on both sides, seeds were packaged in plastic

bags (polyethylene, thickness: 40 microns) to prevent them from moving and radiation was carried out on one side or on both sides.

3. Effect on growth

(1) Soybean

In the soybean, the growth height and the induction effect of phytoalexin were investigated. With regard to the growth height, vermiculite was used as the "soil" for initial growth and field dirt was used directly for long-term growth. In the initial growth (10 days), the temperature was maintained at 26°C and the light/dark cycle was set at 12 hours. In a greenhouse installed in the field the long-term growth was carried out by maintaining the minimum temperature at 17°C or greater. For extraction of phytoalexin, cotyledon that was grown for 8 days in vermiculite was used. The extracting procedure complied with the method employed by Sharp et al. [1].

(2) Barley and maize

With regard to barley and maize, effect on the initial growth was investigated. Seeds were placed on a mesh material complying with the size of the seeds and grown by floating them on an aqueous solution of hyponex. Temperature was set at 26°C and the light/dark cycle at 12 hours.

Test results and considerations

1. Effect on irradiation depth with regard to soybean

Figure 1 shows the growth height after 10 days for soybean seeds irradiated on one side or both sides with electron beam of energy 150-2000 keV in the dose of 10 kGy per side. The growth height of the seeds irradiated on one side increased in comparison with the control in the case of low energy irradiation up to 250 keV. However, at 500 KeV or greater, the growth height decreased as the energy increased and normal growth was not found in 500 keV/both-side irradiation and irradiation with energy of 1000 keV or greater. In particular, seeds irradiated on both sides did not germinate at all at 1000 keV or greater.

The noticeable suppression phenomenon in the growth height found in the samples irradiated on both sides was hardly recognized in irradiation on one side with energy of 150 keV but it was clearly observed at 250 keV or greater. The big difference between irradiating on one side and irradiating on both sides is that in the latter, hypocotyl is always irradiated. Therefore, the hypocotyl irradiated with energy of 250 keV indicates a minus growth effect as a whole and hypocotyl irradiated with energy of 500 keV or greater does not indicate normal growth at all.

However, a negative effect of irradiating the hypocotyl is not recognized at 150 keV and it is possible to say that the effect of promoting growth is apparent as a whole.

2. Growth height in low-energy irradiation

Figure 2 shows the growth height of soybean irradiated on one side in the dose of only 10 kGy with energy of 200 and 250 keV. 5-10% greater values are indicated in the irradiated group in comparison with the control. Also, when the dose dependency was investigated, growth was promoted at 5-10 kGy in soybean irradiated with 250 keV, but, conversely, the growth height was a smaller value than the control doses of 15 kGy or greater.

In the growth height of maize, an effect of growth promotion of about 10% was recognized for 200 keV/10 kGy. In dose dependency, as anticipated, the growth height decreased in comparison with the control at 15 kGy or greater.

Figure 3 shows the roots of soybean before the flower buds appeared. In addition to the irradiated roots growing larger than the non-irradiated roots, even the amount of leguminous bacteria increased noticeably. This kind of effect of promoting root growth according to radiation was clearly recognized not only in the soybean but also barley.

3. Determining the quantity of phytoalexin

Figure 4 is the result of having measured the absorbance at wavelength 285 nm of a liquid obtained by extracting phytoalexin in soybean cotyledon according to the method employed by Sharp, et al. [1]. It is known that the quantity of phytoalexin is proportional to the absorbance at 285 nm. As is apparent from the graph, induction of phytoalexin is promoted in cotyledon obtained from irradiated seeds.

4. Conclusion

Radiation by low-energy electron beam (150-250 keV) promotes growth of seeds (soybean, maize). Noticeable effect in promoting root growth was found in soybean and barley. In particular, the fact that these effects on promoting growth were found at a dose much greater than the dose that causes stimulation effect in so-called regular radiation of 10 kGy is considered to be due to the fact that the irradiation depth of the low-energy electron beam is restricted to the top-most surface where damage is not caused. However, if the dose exceeds 15 kGy, a tendency for the growth to be suppressed was recognized. Furthermore, the growth was suppressed in soybean even when the hypocotyl was irradiated directly at 250 keV or greater. In particular, it did not germinate at all at 1000 keV or greater.

Also, it was found that induction of phytoalexin was promoted more in cotyledon obtained from soybean seeds irradiated with low-energy electron beam than in those that were

not. In order to investigate the relationship between the effect of promoting growth and promoting induction of photoalexin, it is necessary to systematically determine the quantity of phytoalexin.

Reference

[1] Sharp, J.K., Valent, B. and Albersheims, P., J. Biol. Chem. 259, 11312 (1984)

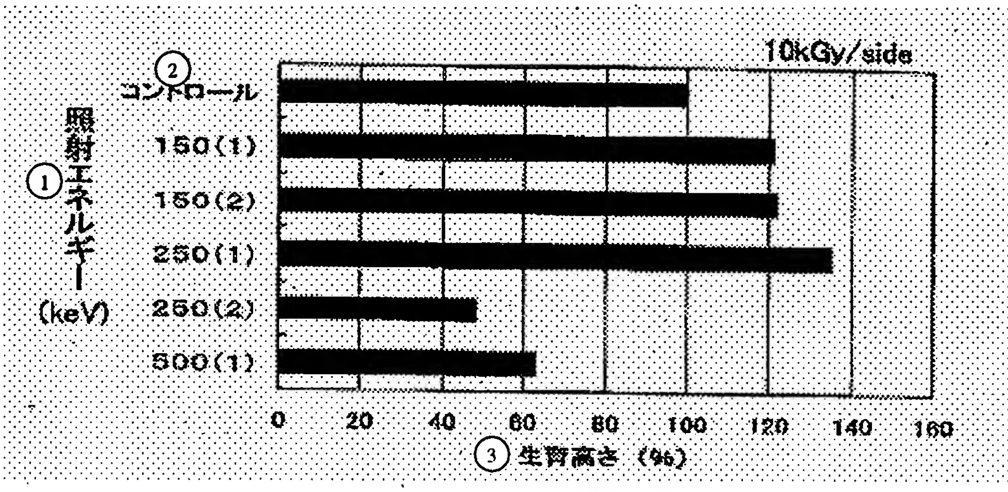

Figure 1. Effect of irradiation depth with respect to growth of soybean

Key: 1 Irradiation energy (keV)
2 The control
3 Growth height (%)

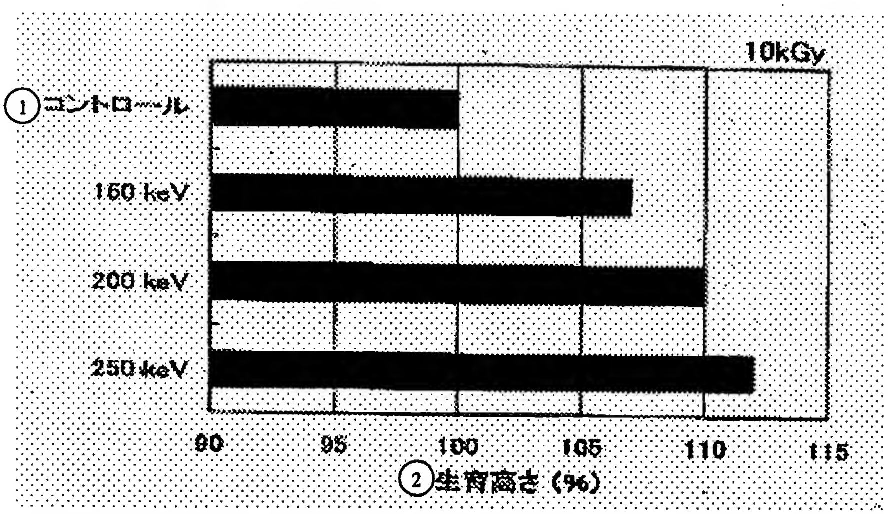

Figure 2. Growth height of soybean (one side irradiation: 10 kGy, after 10 days)

Key: 1 The control
2 Growth height (%)

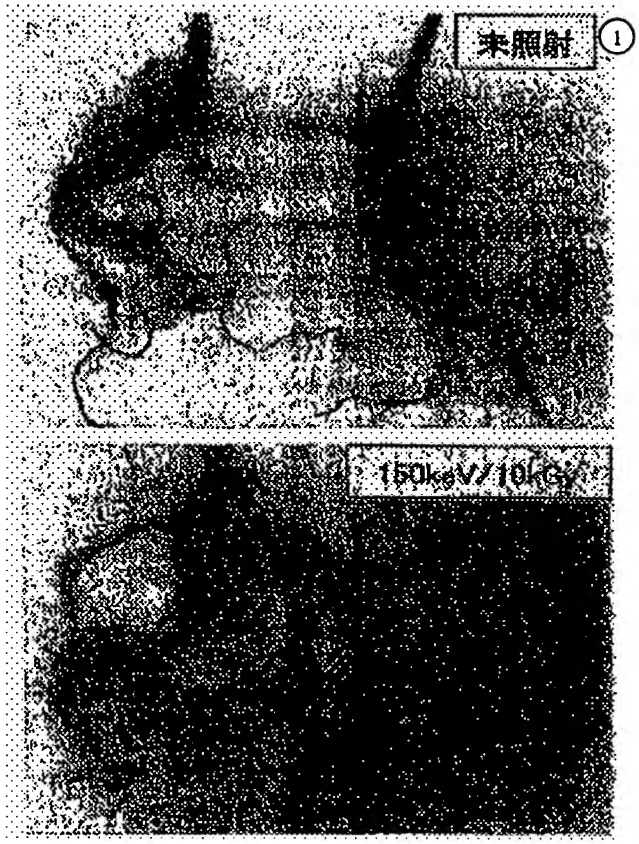

Figure 3. Growth of soybean root (after 30 days)

Key: 1 Non-irradiated

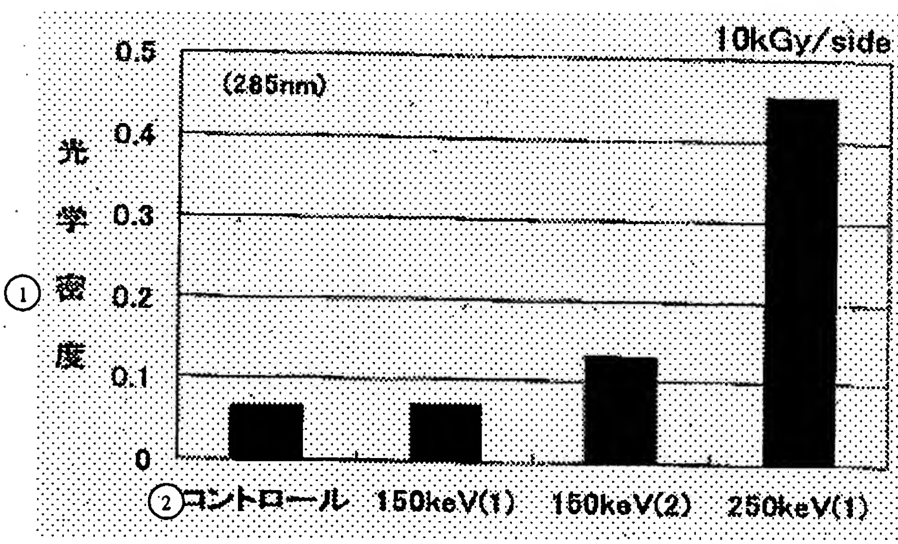

Figure 4. Quantity of phytoalexin in soybean cotyledon

Key:	1	Optical density
	2	The control